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to Contain Corruption**

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# Social Accountability: Persuasion and Debate to Contain Corruption

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## Abstract

In this paper we investigate the properties of simple rules for reappointment aimed at holding a public official accountable and monitor his activity. The public official allocates budget resources to various activities which results in the delivery of public services to citizens. He has discretion over the use of resource so he can divert some of them for private ends. Because of a liability constraint, zero diversion can never be secured in all states. The optimal reappointment mechanism under complete information is shown to exhibit some leniency thus departing from the zero tolerance principle. Under asymmetric information (about the state), a rule with random verification in a pre-announced subset is shown to be optimal in a class of common rules. Surprisingly, those common rules make little use of hard information about service delivery when available. Similarly, PO's claim about his record is of no value to improve the performance of the examined rules. In contrast requesting that the PO defends his records publicly can be very useful if the service users can refute false claims with cheap talk complaints: the first best complete information outcome can be approached in the absence of any observation by the manager of the accountability mechanism.

JEL: D73, D81, D86, H11

## 1 Introduction

Typically, we do not observe high power incentive contracts for public officials and politicians. Most often the official receives a fixed salary and incentive transfers are rare. Instead the decision as to whether or not to keep the official in office is used to discipline public officials. Politicians can be ousted from power by general elections and high level bureaucrats by politicians or bureaucratic procedures.

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The recent developments of the so called transparency and accountability initiatives have come about because of a great frustration with elections and bureaucratic procedures as the dominating means for holding politicians and high level bureaucrats accountable for their decisions.<sup>1</sup> There is a broad consensus that those instruments are grossly inefficient in terms of monitoring public officials and fighting corruption and that they need to be complemented with novel mechanisms.

Transparency and accountability initiatives have a long tradition in the US (cf. Open Government) with recent very interesting developments (see e.g., Noveck 2009). There is also a recent fascinating upsurge of activities in developing countries including India. Partly, this is due to the enactment of the Right to Information Act, partly to the development of new technologies that allows for innovative approaches based on web 2.0 technology. For a review of those initiatives see e.g., Posani and Aiyar (2009). As emphasized in multiple evaluation reports (see e.g., Mc Gee and Gaventa 2010) "we are facing a serious deficit of understanding of the mechanisms at work in those initiatives which makes their evaluation hazardous". The present paper aims at contributing to filling this gap.

Accountability is a composite concept. It has been described (see e.g., Malena et al. 2004) as comprising three elements: "answerability" - the obligation to justify one's action; "enforcement" - the sanction if the action or the justification not satisfactory; and "responsiveness" - the willingness of those held accountable to respond to demand made. The first element is informational, we can formulate it as the obligation to persuade of the suitability of one's action upon request. The second is incentives (or effective sanction). The third element is monitoring. Accountability can be reformulated as a monitoring mechanism that includes an obligation to participate to an ex post persuasion procedure. As already mentioned the use of incentive is typically very constrained: the wage is fixed and the sanction is often reduced to "no reappointment". The emphasis in this paper is therefore on (ex-post) mechanisms that determine how the public official (PO) can persuade the citizens that he deserves reappointment.

The kind of situation that we consider is the provision of public services such as education, health or any other valuable service to citizens.<sup>2</sup> In our model, the provision of public services depends on the resources the PO allocates to the service as well as on some stochastic (service specific) state of productivity only observed by the PO. Our main focus is on corruption here described as diversion of public funds from the provision of public services to private ends. The public official has effective discretion to divert resources because of a liability constraint (the hardest punishment is dismissal) and because of the just described informational asymmetry. In the absence of any signal of the PO's behavior (e.g., performance measure, outcome of verification, announcements, users' complaints

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<sup>1</sup>Criminal courts are not perceived as alternative either. Partly this is because the process is too much too slow and very demanding in terms evidence.

<sup>2</sup>They have been subject to the so called "social audit" in India (e.g., in Andhra Pradesh the National Rural employment Guarantee Act has been the playground for well documented accountability initiatives).

etc...) the citizens have no way to prevent a corrupt PO from diverting money: the PO is in effect not accountable at all for the use of resources.

The question we ask in this paper is whether and how much accountability can be improved (diversion reduced) when relying on an ex-post mechanisms that generates new information through a direct verification procedure and through a simple communication game that captures basic features of social accountability mechanisms encountered in reality. On the one hand we have a PO who implicitly or explicitly claims that he spends the money properly and always want to be reappointed in office. On the other hand we have the citizens who also want to reappoint the PO but only if he spend the money properly. They know a corrupt PO diverts money unless he is punished for doing so.<sup>3</sup> They have to devise a mechanism to learn about his behavior and sanction it. The most natural thing that comes to mind is verification i.e., to verify the (explicit or implicit) claims of the PO and if diversion is detected dismiss the PO. Clearly, if the citizen can verify all the claims, they have complete information and first-best can be achieved. Systematic verification is not a realistic option however. Citizens typically lack the necessary time (not to mention willingness) and information processing capacity. But they could appeal to a professional auditor and pay for his services. In this paper we do not consider costly verification. One reason - consistent with our concern for corruption - is that in most LDC there exists no reason to trust independent auditors more than bureaucratic audit.<sup>4</sup> The failure of bureaucratic verification is precisely what triggers the development of citizen based initiatives: bureaucrats collude with the PO and the PO is expected to collude with an outside auditor. Therefore instead of costly verification we consider limited verification i.e., only a few - most of the time only one - service can be verified. The verification is performed by the citizens themselves: they process the evidence provided by the PO upon their request.<sup>5</sup> The question boils down to the design of a selection rule that determines which one of all the services will be verified. Our focus is therefore on accountability mechanisms of the form: to persuade the citizens that the PO did not divert fund and be reappointed, he must provide some evidence specified by the mechanism. Otherwise, i.e., if he fails to provide the evidence, the citizens believe that he diverted money and he will be dismissed. The accountability mechanism is announced before the PO makes his allocation decision. The objective is to minimize diversion (monitoring).

Our first finding is that because of the fixed wage, the first best complete information outcome exhibits diversion of funds in some states. The optimal accountability mechanism departs from the zero tolerance principle. Instead, it is characterized by a satisfaction level (a sufficient target) above which the PO is implicitly allowed to divert funds. In the absence of any information about the PO's behavior,

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<sup>3</sup>In this paper the term corruption is used in the sense of embezzlement.

<sup>4</sup>The recent scandals with auditing firms e.g., Enron show that even in developed economies, collusion is very difficult to prevent.

<sup>5</sup>In contrast with Rubinstein 2006 we do not let the PO choose which service to provide evidence on.

the optimal P-rule based on random verification calls for verification in a pre-announced subset of services. It secures no diversion within the subset if services only. Surprisingly, the availability of information about the quality of service delivery (a signal of PO's behavior) is of very little value. In particular we find that a most intuitive mechanism which consists in a rule that calls for the verification of one of the services where diversion might have occurred i.e., low quality services, is a very bad idea. It leads to maximal diversion. The intuition is that such a rule increases the PO's cost of refraining from diversion in the first place. Instead diluting detection probability maximally by diverting whenever possible becomes optimal. We next show that combining random verification with a necessary performance target weakly improves upon the optimal random verification outcome. As we investigate the value of communication, we first find that asking the public official to defend his records is of no value in those mechanisms. However, the picture changes dramatically if we introduce service users and invite them to submit cheap talk complaints. We show that requesting that the public official publicly defends his record when service users can refute his claim can be exploited in a mechanism that approaches the complete information first best. This result supports the intuition behind social accountability initiatives. It reveals that a well-designed persuasion game involving the public can play a significant role in securing the accountability of public officials and reducing the extent of corruption. The analysis offers a framework that can be generalized along various dimensions and provide concrete recommendations as to how new technology can be used to improve governance in specific contexts.

#### *Related literature*

The issue of accountability has been addressed in the political science and political economy literature (e.g., Persson et al., 1997). The emphasis in that branch of literature is on election rules and organizational structure. Our approach shares common features with the literature on optimal monitoring with ex-post verification (cf Townsend 1979, and Gale and Hellwig 1985). In contrast with e.g., Townsend, we do not consider an explicit cost of verification instead we assume limited verification resources. Moreover we are interested in the value of communication. This brings us closer to the persuasion literature (cf. Glazer Rubinstein 2004, 2006). A contribution of this paper is to introduce moral hazard in a persuasion problem. We show that a persuasion mechanism can be used to monitor the action of the agent in a (constrained) principal-agent problem.

The paper is organized as follows. In section 2 the general model is introduced. Section 3 characterizes the complete information first-best benchmark. Section 4 derives the optimal mechanism with verification in the absence of any observation. Section 5 investigates a number of accountability rules when information about service delivery is available. Finally, Section 6 develops the full mechanism with both communication and verification and concluding remarks are gathered in the last section.

## 2 The model

There is a finite number  $n$  of different services in  $N$ , which have to be provided to the citizens. To provide these services, a public official (PO) is hired with the task to allocate a budget  $B$  to the provision of these services but the PO can choose to divert money to private ends instead. For each service  $i$ , the quality delivered to the citizens, denoted  $s_i$ , is a function of the share of the budget spent on  $i$  and an exogenous and uncertain productivity parameter of the service  $\theta_i : s_i = f(\theta_i, b_i)$  where  $b_i$  is the share of the budget allocated to service  $i$ . The quality of each service  $i$  can be either null, low or high,  $s_i \in \{0, \underline{s}_i, \overline{s}_i\}$ <sup>6</sup> where  $s_i = 0$  is a quality of service below the minimum acceptable level. A provision of services below the minimum level is liable of prosecution.<sup>7</sup> The productivity  $\theta_i$  of each service is high ( $\overline{\theta}_i$ ) with probability  $p$  and low ( $\underline{\theta}_i$ ) with probability  $1 - p$ . The technology for the delivery of the qualities of service is the following:

- $f(\theta_i, b_i) = \overline{s}$  for  $b_i \geq \frac{B}{n}$  and  $\theta_i = \overline{\theta}_i$
- $f(\theta_i, b_i) = \underline{s}$  for  $b_i < \frac{B}{n}$  and  $\theta_i = \overline{\theta}_i$  or  $b_i \geq \frac{B}{n}$  and  $\theta_i = \underline{\theta}_i$ ;
- $f(\theta_i, b_i) = 0$  for  $b_i < \frac{B}{n}$  and  $\theta_i = \underline{\theta}_i$ .

Since the only purpose of allocating money to the production of services is to provide quality with this technology the choice of  $b_i$  can be simplified to  $b_i \in \{0, \frac{B}{n}\}$  and the mandate of the PO simplifies to spending  $\frac{B}{n}$  (also referred to as a unit of budget) on each service.<sup>8</sup> There are two crucial features to this production technology:

- The delivery of a low quality service  $\underline{s}$  can result from either spending the appropriate budget on a low productive service  $f(\underline{\theta}_i, \frac{B}{n}) = \underline{s}$  or spending 0 (diverting money) on a productive service  $f(\overline{\theta}_i, 0) = \underline{s}$ .
- The amount that the PO can divert (discretionary budget) depends on the state of the world e.g., in state  $\theta = (\theta_1, \dots, \theta_n)$  with  $\theta_i = \underline{\theta}_i$  for all  $i = 1, \dots, n$ , there is no discretionary budget to be diverted. The PO cannot afford delivering below the minimal level.

The PO's decision  $(x_1, \dots, x_n)$  consists, for each service  $i$ , to either spend the share  $\frac{B}{n}$  on service  $i$  denoted  $x_i = 0$  or to keep the money for himself  $x_i = 1$ . This decision is taken after having observed the realization of the vector of productivities  $\theta = (\theta_1, \dots, \theta_n)$ .

The PO's objective is to maximize his expected payoff including the money he diverts and the revenue when remaining in office

$$EU = \sum_{i \in N} x_i \frac{B}{n} + P(K)w$$

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<sup>6</sup>The idea is that service users distinguish between three level of services: unacceptable, low and good.

<sup>7</sup>This captures the idea that it may endanger the life of citizens or deny their basic rights, e.g., the hospital or the school is kept close.

<sup>8</sup>This corresponds to the allocation that secures the best value for money.

where  $P(K)$  is the probability that the citizens, denoted CI, reappoint the PO and  $w$  is the (discounted) continuation wage.<sup>9</sup> The probability  $P(K)$  depends on the procedure for reappointment which is the choice of the CI (see below). The CI wishes to minimize the expected diversion of public budget:

$$EV = E_{\theta} \sum_{i \in N} x_i(\theta) \frac{B}{n}.$$

In the analysis we also use an alternative but equivalent formulation in terms of saved discretionary budget.

To discourage the PO from stealing, we assume that the CI can commit to a procedure of reappointment. It involves a rule for verifying the state of productivity and (when unobservable) the quality of some service(s) and a rule for deciding whether the CI reappoints the PO or dismisses him. The CI is assumed to only have resources to verify one single service reflecting limited capacities to process evidence provided by the PO. More formally at the beginning of the period, CI commits to a persuasion or P-rule. A P-rule is composed of two mappings  $f$  and  $d$ :

- The first mapping depicts the rule for selecting one service if any for verification:  $f : I^0 \rightarrow P$  where  $I^0$  is the information set at time 0:  $I^0 \in \{\Theta \times S, S \times A, \emptyset \times A \times \Sigma\}$  with  $\Theta$  denoting the set of states,  $S$  the set of services,  $A$  the set of announcements from the PO and  $\Sigma$  the set of signals from service users<sup>10</sup>.  $P$  is the set of probability distributions over the elements of  $N$  so  $(p_1, \dots, p_n)$  is a probability vector. With probability  $p_i$  element  $(\theta_i, s_i)$  is verified, the CI can only verify one service.
- The second mapping depicts the rule for reappointment. We confine attention to deterministic decision rules of the form:  $d : I^1 \rightarrow \{K, D\}$  with  $I^1 = \{I^0 \times X_i\}$ , where  $X_i = \{0, 1\}$  is the set of outcomes from verification  $x_i \in X_i$  where 0 means the PO did not divert and 1 means he diverted the unit of budget  $(\frac{B}{n})$  intended to service  $i$ .  $K$  means reappoint (Keep) and  $D$  stands for dismiss.<sup>11, 12</sup>

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<sup>9</sup>The present paper depicts a situation where the budget allocation task is unique but takes place in a long-running relationship so  $w$  is the discounted wage. In a repeated allocation game the discounted income would include future rents from stealing as well.

<sup>10</sup>We postpone to section 6 development about  $\Sigma$ .

<sup>11</sup>To the best of our knowledge no public administration uses a stochastic dismissal rule presumably because appealing to a random device to decide over the fate of people is not politically feasible. Therefore, we focus on deterministic dismissal rules. The probabilistic character of the mechanism is introduced through verification, signaling or communication.

<sup>12</sup>Interestingly a case where a random device was discussed became wellknown. Under the second world war British pilots suffered great losses because they had to carry a lot of gasoline to be able to fly back. Some smart scientists showed that expected survival could be increased significantly if instead the pilots were selected randomly and then sent to a sure death in planes with no gasoline to turn back. The proposal to introduce the new system was unanimously rejected. Having one's fate determined by a random device was not acceptable.



The general timing of the interaction between the PO and the CI is as follows:

- (1) The CI publicly commits to a P-rule (a  $f$  and a  $d$  mapping),
- (2) Nature picks the profile of productivities  $\theta$  which is perfectly observed by the PO,
- (3) The PO decides on how to spend money on the different services, he takes decision  $(x_1, x_2, \dots, x_n), x_i \in \{0, 1\}$ ,
- (4) Services  $(s_1, \dots, s_n)$  are delivered to the service users which is observed or not by the CI
- (5) A message from the PO may be demanded and/or a signal from service users.
- (6) A service  $i$  is selected and verified according to the P-rule ( $f$  mapping).
- (7) CI decides whether to keep or dismiss the PO according to  $d$  mapping.

Our basic framework is characterized by linear utilities and a liability constraint is imposed: the largest cost that can be imposed on the PO in case of low quality delivery is dismissal (the loss of  $w$ ). We have the following 2 assumptions:

- $B > w$  meaning that the PO always prefers to divert the whole budget and lose his job rather than refraining from diverting altogether. But
- $\frac{B}{n} < w$  so the PO does not always divert whatever he can.

The two assumptions above can be summarized in a number  $l \in [2, n]$  such that  $l\frac{B}{n} < w$  whereas  $\frac{B}{n}(l+1) \geq w$ ,  $l$  is the largest amount of budget shares such that the PO prefers to keep his job rather than divert  $l\frac{B}{n}$ .

**Definition 1** Let  $l = \max_{y \in N} \{y; y < \frac{wn}{B}\}$ .

The magnitude  $l(B, w)$  will play a central role in the analysis. We have  $\frac{dl}{dw} \geq 0$  and  $\frac{dl}{dB} \geq 0$ . For  $w$  large enough or  $B$  small enough  $l = n$ , perfect monitoring is, as we shall see, easily achievable when relying on verification. The liability constraint i.e., the constraint on "punishments" (losing fixed  $w$ ) relative to "power" ( $B$ ) is what creates the challenge of accountability. We assume that when he is indifferent between stealing or not the PO chooses not to.

For the rest of the paper it is useful to introduce the following notation. The set  $\Theta$  of states  $\theta$  is partitioned into classes characterized by the number of high productivity services. We call class- $k$  the element of the partition of  $\Theta$  where there are exactly  $k$  high productivity services and denote this subset  $\Theta(k)$ . The cardinality of  $\Theta(k)$  is  $= \frac{n!}{k!(n-k)!}$ . With some abuse of language we shall also be referring to a PO of type  $k$  in the sense of a PO who inherited a state in class( $k$ ). We use the two formulations interchangeably.

### 3 Benchmark: Accountability with full observability

We first look at a particular situation in which the CI actually has access to all the information:  $I = \Theta \times S$ , he observes the productivity state  $\theta$  and the service quality  $s$ . It follows that CI perfectly detects any diversion of funds by the PO. A natural candidate for the P-rule (only the  $d$ -mapping since no verification is needed) is to dismiss the PO for any amount he steals. We call this P-rule the zero tolerance rule. We next show that this rule does not perform so well and that CI can do much better.

With the proposed P-rule the PO is dismissed whether he steals one share or the whole (discretionary) budget since utility increases in stolen money he faces a binary choice: either steal the whole discretionary budget or steal nothing. We denote by  $\hat{x} = \sum x_i$  (recall  $x_i = 1$  if the PO diverts and  $x_i = 0$  otherwise) the type  $k$  PO's incentive constraint thus writes<sup>13</sup>:

$$k \frac{B}{n} \leq w \quad (1)$$

where the rhs is the gain from diverting the discretionary budget and facing dismissal and the lhs is the gain from allocating according to the mandate. Recall that by assumption we have  $\frac{B}{n} \leq \frac{1}{l}w$  whereas  $(l+1) \frac{B}{n} > w$ . This means that whenever  $\theta \in \Theta(k)$  with  $k \leq l$ , the candidate P-rule achieves full deterrence. However for  $\theta \in \Theta(k)$ ,  $k \geq l$  the threat of dismissal induces a PO of type  $k$  to steal the whole discretionary budget since  $(l+1) \frac{B}{n} > w$ . In expectation the budget saved from diversion is equal to  $\sum_{i=0}^{i=l} q(i) \frac{i}{n} B$  where  $q(z) = \text{prob}\{\theta_i \in \Theta(z)\}$ .<sup>14</sup>

Now consider a rule where the PO is granted some leniency or a sufficient target in the sense that CI commits to keep the PO if he delivers HQ services whenever possible i.e.,  $\theta_i = \bar{\theta}$  up to a target  $y$  of HQ services. Once the PO has delivered  $y$  HQ services, CI is satisfied, he "closes his eyes" so the PO may unsanctioned steal above the target.

More precisely, suppose that the CI commits to the following rule, the lenient P-rule: for any  $\theta \in \Theta(k)$ ,  $k < y$  the PO is dismissed for stealing any amount of discretionary budget; and for  $\theta \in \Theta(k)$ ,  $k \geq y$  the PO is kept if and only if he delivers at least  $y$  services and he is dismissed otherwise. For the sake of comparison we shall express this rule in terms of the general mechanism. The first mapping  $f : \Theta \times S \rightarrow P$  is trivial since there is no use to verification because of complete information:

$$- f(\theta, s) = (0, \dots, 0) \quad \forall \theta \in \Theta \text{ and } s \in S.$$

The second mapping  $d : \Theta \times S \rightarrow \{K, D\}$  is defined as follows. Let  $\hat{s}$  be defined as  $\#s_i \in S; s_i = \bar{s}$ :

$$- d(k, \hat{s}, \hat{x}) = K \text{ if either } \hat{s} = k, k < y \text{ or } \hat{s} \geq y, k \geq y \text{ and}$$

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<sup>13</sup>We remind that we call type  $k$  PO a PO that faces a state belonging to  $\Theta(k)$  that is with a discretionary budget equal to  $\frac{kB}{n}$ .

<sup>14</sup> $q(z) = \text{prob}\{\theta_i \in \Theta(z)\} = \frac{n!}{z!(n-z)!} p^z (1-p)^{(1-z)}$

-  $d(k, \hat{s}, \hat{x}) = D$  if either  $\hat{s} < k$  and  $k < y$  or  $\hat{s} < y$  and  $k \geq y$ .

When he faces this P-rule, the PO chooses how many budget share to divert  $\hat{x}$ , the incentive constraints of a PO of type  $k$  writes

$$\hat{x} \frac{B}{n} \leq w \text{ for } k \leq y \quad (2)$$

$$\hat{x} \frac{B}{n} \leq w + (k - y) \frac{B}{n}, \text{ for } \hat{x} \leq y, k > y \quad (3)$$

since the diversion payoff (lhs) is increasing in  $\hat{x}$  the constraints are most demanding at  $\hat{x} = k$  respectively  $\hat{x} = y$ . Both are satisfied for  $y \leq l$  since by definition  $l \frac{B}{n} \leq w$ . For  $k \leq y$  the PO chooses not to divert. And for  $k > y$  he chooses to divert exactly  $k - y$ .

We now integrate the PO's optimal behavior in CI's objective function which for convenience we write in terms of saved expected discretionary budget i.e., the total expected discretionary budget less the part diverted by the PO<sup>15</sup>:

$$EV^{fi} = \sum_{i=0}^{i=y} q(i) \frac{i}{n} B + (1 - Q(y)) \frac{y}{n} B \quad (4)$$

where  $Q(z) = \sum_{i=0}^{i=z} q(i)$  so  $(1 - Q(z))$  is the probability for the PO to be of type  $i \geq z$ . The first term of the expression in (4) is the expected discretionary budget up to class  $\Theta(y)$  which is never stolen. The term is the same as with the zero tolerance rule. The second term is the discretionary budget associated with the share  $l$  of HQ services that must be delivered in states belonging to classes  $\Theta(k)$  with  $k > y$ . This term is absent under the zero tolerance regime. We have the following proposition:

**Proposition 1** *With full observability, the “lenient P-rule” with a target  $y^* = l$  achieves*

- (i) *high quality delivery of all productive services in every state in  $\Theta(k)$  for  $k < l$  and*
- (ii) *high quality delivery of  $l$  productive services in every state in  $\Theta(k)$  for  $k \geq l$ .*
- (iii) *This rule is optimal under Full Observability.*
- (vi) *In the optimal scheme the expected saved budget is  $EV^{fi} = \sum_{i=0}^{i=l} q(i) \frac{i}{n} B + (1 - Q(l)) \frac{l}{n} B$ .*

**Proof.** The optimal lenient P-rule maximizes  $EV^{fi}$  subject to the IC constraints,  $y \leq l$  maximizes  $\frac{\Delta EV^{fi}}{\Delta y} = q(y+1) \frac{y+1}{n} B + (1 - Q(y)) \frac{B}{n} - q(y+1) \frac{y}{n} B > 0$  so it saturates the constraint and  $y^* = l$ . ■

Proposition 1 characterizes the largest expected utility achievable by the citizens when keeping the PO accountable for his action. In the following we refer to the outcome in Proposition 1 as the first-best. It is the best outcome that can be achieved within the institutional constraints captured by  $l(w, B)$  that define our problem. For  $w$  large enough relative to  $B$  we have  $l(w, B) = n$  so the first-best in that case corresponds to perfect monitoring. The remaining of paper investigates how

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<sup>15</sup>Since the total expected discretionary budget is a constant, it is easy to see that the two formulations are equivalent.

close one may get to the first-best outcome in the absence of complete information. We shall in turn consider the case when no information is available ex-post, when the CI has information about service delivery, when he can ask the PO for announcement and receives complaints from service users.

The result in proposition 1 are consistent with Persson et al. (1997). They also find that the politician must be granted some rents which they call power rents in order to refrain from stealing the whole budget.

## 4 Accountability with no information

In this section we look at the case polar to full information: CI does not observe the state of productivity or the quality of delivered services. We postpone to section 5 and 6 the introduction of messages from the PO and service users. For the case  $I = \emptyset$  there is no information to condition verification probabilities for the different services. The  $f$ -mapping boils down to the set of probability distributions  $P$ ,  $\mathbf{p} = (p_1, \dots, p_n)$ ;  $\sum_{i=0}^n p_i \leq 1$ . Since the services are symmetric for the CI, we can focus on verification rules that treat services symmetrically. The second mapping  $d : X_i \rightarrow \{K, D\}$  is trivially determined:  $d(0) = K$  and  $d(1) = D$ . The only feasible alternatives make no use of the only available information i.e., from verification and hence can have no monitoring power whatsoever. In this context the only decisions for the CI with respect to the P-rule is therefore the selection of the probabilities for verification of each service and what announces before the PO makes his decisions.

### 4.1 Random verification procedures

For any given  $\mathbf{p} = (p_1, \dots, p_n)$ ,  $\sum p_i \leq 1$ , PO's objective function writes

$$EU = \sum_{i \in N} x_i \frac{B}{n} + (1 - \sum_{p_i; x_i=1} p_i)w$$

so the marginal payoff from stealing on service  $i$  is determined by the constant gain  $\frac{B}{n}$  and the expected loss  $-p_i w$ . Note that the marginal payoff does not depend on whether the PO diverts on other services. This follows from the linearity of utility in money. The IC constraint writes

$$\frac{B}{n} - wp_i \leq 0 \Leftrightarrow wp_i \geq \frac{B}{n} \quad (5)$$

Since by assumption  $\frac{B}{w} > 1$ , we have that the IC constraint requires  $p_i \geq \frac{1}{n}$ . This gives us the following lemma.

**Lemma 1** *Any P-rule that aims at preventing stealing from service  $i$  must have  $p_i \geq \frac{B}{wn}$ .*

The proof follows immediately from the IC constraint (5). The Lemma allows establishing the following results

**Proposition 2** *i. In any state  $\theta \in \Theta(k)$ ,  $k = 1, \dots, n$  uniform random verification over the set  $N$  of all services has no monitoring power. A PO of type  $k \forall k \in [0, N]$  diverts the whole discretionary budget and is dismissed with probability  $\frac{k}{n}$ ;*

*ii. For any  $M \subset N$ ; a partial verification rule that entails uniform random verification over a pre-announced subset  $M$ ,  $\#M = m$  such that  $p_i = \frac{1}{m} \geq \frac{1}{l}$  for  $s_i \in M$ , secures no stealing in  $M$ .*

**Proof.** i. Uniform random verification entails  $p_i = \frac{1}{n}$  for all  $i$  but by Lemma 1  $p_i$  must be larger than  $\frac{B}{wn}$  implying  $p > \frac{1}{n}$ . Hence random verification ( $p_i = \frac{1}{n} \forall i$ ) violates the IC constraint in all states. In any state  $\theta \in \Theta(k)$ , the PO steals  $k$  shares of the budget and he is discovered with probability  $\frac{k}{n}$  in which case he is dismissed.

ii. First note that there is no point in performing verification on  $M \subset N$  if the subset  $M$  is not pre-announced. Indeed since all services are symmetric, the probability for verification for the PO is then  $\text{prob}\{s_i \in M\} \cdot \frac{1}{m} = \frac{m}{n} \frac{1}{m} = \frac{1}{n}$  which we know by (i) has no monitoring power. When the set  $M$  is pre-announced with  $p_i \geq \frac{1}{l}$ ,  $i \leq m$ , we have  $\frac{B}{n} < \frac{w}{p_i}$  for any  $s_i$ ,  $i \leq m$  so the PO prefers to spend the money properly  $x_i = 0$ ,  $\forall i$ ,  $i \leq m$ .

We next derive the optimal APV (pre-Announced Partial Verification) that maximizes CI's objective. We want to establish the magnitude of the potential gains from partial verification and the loss due to asymmetric information. ■

## 4.2 Optimal Partial Verification.

Generally, departures from uniform verification over  $N$  can take many forms. Simple arguments allows to narrow down significantly the set of interesting APV however. We know from Proposition 2 that any candidate optimal rule will feature the property that some services are verified with sufficient probability to deter stealing. Next, since verification is a scarce resource there can be no rationale for spending it for no good i.e., to verify a service with a probability that is positive but insufficient to deter stealing. Any optimal use of verification resources must entails that some services are never verified while other are verified with sufficiently high probability. We can therefore focus on APV schemes that pre-announces a partition of the set of services into two subsets  $M$  and  $N \setminus M = U$ . The set  $U$  (for *unverified*) contains services that are never verified and the set  $M$  contains services that are verified with equal probability. In the previous section we settled the question regarding the reappointment rule  $d$ . It uses the only available information, i.e., the result from the verification procedure in the most natural way: dismiss if diversion is uncovered and reappoint otherwise. The relevant set of APV P-rule is:

$$\begin{aligned} f: \mathbf{p} &= (p_1, \dots, p_n) \text{ with } p_i = \frac{1}{m}, i \leq m, p_i = 0, i > m \text{ and} \\ d: X &\rightarrow \{K, D\}; d(x_i = 0) = K \text{ and } d(x_i = 1) = D, x_i; i \leq m \end{aligned}$$

The question that we next investigate is what is the optimal  $m = \#M$  (recall the services are fully symmetric)?

Consider a PO of type  $k'$ 's optimal response to  $APV(m)$ . Assume there are  $k' \leq k$  productive services in  $U$  when the state is  $\theta \in \Theta(k)$ . the PO can guarantee himself a payoff of  $\frac{k'}{n}B + w$  when diverting from all high productivity services in  $U$ . If in addition, the PO can steal some amount  $\hat{x}_m \in [0, k - k']$  where  $\hat{x}_m = \sum_{i=1, \dots, m} x_i$ , he gets  $EU = \frac{\hat{x}_m + k'}{n}B + \frac{m - \hat{x}_m}{m}w$ . The incentive constraint for not diverting in  $M$  writes

$$\frac{k'}{n}B + w \geq \frac{\hat{x}_m + k'}{n}B + \frac{m - \hat{x}_m}{m}w \Leftrightarrow \frac{1}{n}B - \frac{1}{m}w \leq 0$$

The marginal payoff from stealing in  $M$  is constant by linearity and equiprobability of verification. Consequently, if  $m > l$ , we have that  $\frac{m}{n}B > w$ , which implies that the PO prefers to divert from any service in  $M$  that is high productive rather than stealing only from  $U$ . Since utility is increasing in  $\hat{x}_m$ , the PO chooses to steal on every productive service in  $M$ , and therefore steals on a total of  $k' + k - k' = k$  services. If  $m \leq l$ , utility is a decreasing function of  $\hat{x}_m$  and the PO chooses to steal only on productive services in  $U$ . We next consider the CI incentives with respect to  $m$ . In order to do that we define classes of states and probabilities in the subset  $M$  in a way similar to what we did before. Let  $q'(z; M) = \text{prob}\{\theta \in \Theta(z; M)\} = \frac{m!}{z!(m-z)!}p^z(1-p)^{m-z}$ . It is the probability that  $\theta = (\theta_1, \dots, \theta_m)$  has  $z$  high productivity parameters. We can now express the expected saved budget for an incentive compatible APV:

$$EV^{APV} = \sum_{i=0}^{i=m} q'(i; M) \frac{i}{n}B, \text{ s.t. } m < l \quad (6)$$

which is unambiguously increasing in  $m$ , hence  $m^* = \arg \max_m EV^{APV} = l$ .

**Proposition 3** *For  $I = \emptyset$ , the optimal partial verification  $P$ -rule yields a pre-announced partition of the set of services into two subsets. The subset subject to verification has cardinality  $l$ . The expected saved public funds is  $EV^{APV} = \sum_{i=0}^{i=l} q'(i; M) \frac{i}{n}B$ .*

*ii. In equilibrium the PO is always reappointed, diversion occurs(in subset  $U$ ) but it is never uncovered by verification.*

**Proof.** i. The argument about pre-announcement is the same as in Proposition 2. Next, by linearity of utility, in any state  $k$ , the PO faces a choice between between stealing the whole discretionary budget or stealing only from  $U$ . The *IC* constraint  $\frac{k'}{n}B + w \geq \frac{x+k'}{n}B + \frac{m-x}{m}w$  simplifies to  $m \leq l$ . It is independent of the true state. Hence, the same set  $M$  of cardinality  $l$  minimizes stealing in all states and thus maximizes the expected saved budget  $EV$ .

ii. Subset  $M$  is designed to deter stealing so verification in subset  $M$  results in  $x_i = 0 \ i \in [1, m]$  and  $d(0) = K$ . Since  $U$  contains services that are never verified for any  $\theta_i, i \in [m+1, n]$ , with  $\theta_i = \bar{\theta}$ ,  $x_i = 1$ , the PO diverts the whole discretionary budget in  $U$ . ■

The result in proposition 3 is not surprising. Announced Partial Verification (APV) follows the same logic as the optimal complete information scheme: it leaves rents in order to avoid full diversion. In contrast with the complete information setting the P-rule cannot be made conditional on the true state of productivity (or type of the PO) and on performance. The efficiency loss due to asymmetric information is only partially mitigated by limited (to one item) ex-post verification.

As in the complete information context the impact of the wage and the budget is unambiguous. Since  $\frac{dl}{dw} \geq 0$  and  $\frac{dl}{dB} \leq 0$  we have  $\frac{\partial EV^{APV}}{\partial w} \geq 0$  and  $\frac{\partial EV^{APV}}{\partial B} \leq 0$ . As  $l \rightarrow n$ ,  $EV^{APV} \rightarrow EV^{FI}$ , so provided the wage is high enough relative to the budget, in the absence of information full monitoring is achievable with random verification.

**Remark 1** *As shown in the proof of Proposition 2 pre-announcement is key to the efficiency of APV. Interestingly practitioners are often reluctant to announce  $M$  because they understand that the PO is given "carte blanche" on the complement subset  $N \setminus M$ . They often fail to realize that this is the cost they have to pay to achieve any monitoring effect. Part of the confusion comes from the fact the efficiency of verification and audits is often measured in terms of unveiled diversion i.e., from an ex-post perspective. While the optimal APV never unveils any diversion even though diversion occurs systematically. In this context CI must credibly resist the temptation to verify outside of pre-announced  $M$ . So CI's commitment to an APV scheme can turn out a demanding feature.*

#### 4.2.1 Evaluating the performance of the optimal APV

The first point is that it increases the expected saved budget from 0 with random verification to  $EV^{APV} > 0$ . Yet, there is of course a cost to asymmetric information. Comparing  $EV^{APV*} = \sum_{i=0}^{i=l} q'(i; M) \frac{i}{n} B$  with the complete information optimal outcome  $EV^{fi} = \sum_{i=0}^{i=l} q(i) \frac{i}{n} B + (1 - Q(l)) \frac{l}{n} B$ , we see that the first term of the two expressions are quite similar but since  $q(i) > q'(i; M)$  because  $q'(i)$  is the probability for  $\theta$  belonging to  $\Theta(i; M)$  with  $M \subset N$ , we have  $\sum_{i=0}^{i=l} q'(i; M) \frac{i}{n} B < \sum_{i=0}^{i=l} q(i) \frac{i}{n} B$ . Moreover, partial verification cannot prevent full stealing in the complementary set  $U$  while under full information,  $l$  HQ services can be guaranteed in good states  $(1 - Q(l)) \frac{l}{n} B$ . So partial verification does much better than uniform random verification but much less well than the optimal complete information P-rule. Interestingly the performance of the optimal APV resembles the performance of the zero tolerance P-rule under complete information  $EV = \sum_{i=0}^{i=l} q(i) \frac{i}{n} B$ . It is smaller though since  $q(i) > q'(i; M)$ .

## 5 Accountability with observable service delivery

In this section we investigate a number of natural P-rules feasible when information about service delivery is available. We start with a simple target rule with no verification. We next consider two

types of conditional APV rule. In the first, the choice as to whether or not to carry out verification on a pre-announced set depends on service delivery. In the second, verification always takes place but the set of services subjected to verification depends on available information about service delivery. Finally, we consider the value of using PO's claim about his record.

For the case when  $I^0 = S$  so the set of P-rules is characterized  $f : S \rightarrow P$  and  $d : S \times X \rightarrow \{K, D\}$ . Potentially this set is very large. We here focus on rules that makes use of ex-post information in a simple way.<sup>16</sup> More precisely we focus on P-rules of the form  $p_i(s_i, \hat{s})$  with  $\hat{s} = \#s_i, s_i \in S; s_i = \bar{s}$  i.e., we allow the probability of verification to depend on the own delivery status (i.e., HQ or LQ) while the delivery status of the other services affect the probability through an aggregate measure only  $\hat{s}$ , the total sum of HQ services.<sup>17</sup> Similarly, we limit attention to decision rules  $d : S \times X_i \rightarrow \{K, D\}$  of the form  $d(s_i, \hat{s}, x_i)$ .

## 5.1 Focused verification

In this section we consider the possibly most intuitive P-rule that uses ex-post information: focus verification resources on LQ services since only they may hide diversion. We call it focused random verification (FV). It entails that the set of services subjected to random verification is determined by observed service delivery. More formally

$$\begin{aligned} & - f : S \rightarrow P; p(s_i, \hat{s}) = \frac{1}{n-\hat{s}} \text{ for } s_i = \underline{s} \\ & \text{and } p_i(s_i, \hat{s}) = 0 \text{ for } s_i = \bar{s} \\ & d : S \times X_i \rightarrow \{K, D\}; d(\hat{s}, 0) = K \text{ and } d(\hat{s}, 1) = D \forall \hat{s}. \end{aligned}$$

The IC constraint applying to the choice of the budget allocation decisions  $x_i$  is derived by comparing the payoff when complying marginally i.e., not stealing  $x_i = 0$  given  $\hat{x}_{-i}$  (the amount of diversion from other services). In any state  $\theta \in \Theta(k)$ , given the value of the other allocation variables  $x_{-i}$ ;  $\sum_{j \in N_{-i}} x_j = \hat{x}_{-i}$  the choice is between  $\mathbf{x}_{i=0} = (x_1, \dots, 0, \dots, x_n)$  and  $\mathbf{x}_{i=1} = (x_1, \dots, 1, \dots, x_n)$ , denote  $\hat{x}_0 = \sum_{j \in N_{-i}} x_j$ ,  $\hat{x}_1 = \sum_{j \in N_{-i}} x_j + 1$ ,  $\hat{s}_0$  and  $\hat{s}_1$  are defined as the corresponding sums of HQ services:

$$\hat{x}_0 \frac{B}{n} + (1 - p(\hat{s}_0; k)) w \leq \hat{x}_1 \frac{B}{n} + (1 - p(\hat{s}_1; k)) w \quad (7)$$

where  $p(\hat{s}_0; k)$  is the detection probability in class  $k$  when stealing is equal to  $\hat{x}_0$ . Eq. (7) simplifies to  $[p(\hat{x}_1, k) - p(\hat{x}_0, k)] w > \frac{B}{n}$  which says that the expected marginal loss in terms of increased probability for detection times the continuation wage must exceed the (sure) gain. The new feature compared with previous P-rules is that the change in the probability for detection and dismissal is a function of the whole vector of budget allocations summarized in  $\hat{x}$ . In the P-rule under consideration,

<sup>16</sup>This can be justified appealing to the practical applications.

<sup>17</sup>We cannot preclude that complex conditional schemes that make use of more sophisticated information e.g., the precise combination of the vector of delivery could achieve a better outcome.



the probability for detection depends on the number of LQ services which is  $n - \hat{s}$ . The probability for detection associated with  $\hat{s} = k - \hat{x}$  in state  $\theta \in \Theta(k)$  is

$$p(\hat{s}; k) = \frac{\hat{x}}{n - k + \hat{x}}.$$

We take the derivative<sup>18</sup> with respect to  $\hat{x}$ :  $\frac{\partial p(\hat{s}, k)}{\partial \hat{x}} = \frac{n-k}{(n-k+\hat{x})^2} \geq 0$  and  $\frac{\partial^2 p(\hat{x}, k)}{\partial^2 \hat{x}} = -2 \frac{n-k}{(n-k+\hat{x})^3} < 0$  i.e., the detection risk increases with the total amount stolen but at a decreasing rate. This implies that, in any given class, it may not be IC to steal a single unit, but if it is IC to steal some amount of units, it is optimal to steal the whole discretionary budget. The PO's optimal response is therefore again in terms of a binary choice. We also have that  $\frac{\partial p(\hat{x}, k)}{\partial k} = \frac{\hat{x}}{(n-k+\hat{x})^2} > 0$  so the better the state (larger  $k$ ) the larger the marginal detection risk for any given amount of stolen units. This means that if it is optimal to comply in class  $(k)$  it is optimal to comply in any state belonging to  $\Theta(k')$ ,  $k' > k$ . In each state the IC writes in terms of the binary choice:

$$[p(k, k) - p(0, k)]w > k \frac{B}{n}$$

$$\frac{k}{n}w > \frac{B}{n}k \Leftrightarrow B \leq w$$

which turns out to be independent of  $k$  and which we know is violated. We have the following result:

**Proposition 4** *A P-rule that focuses all verification resources on observed LQ services has no monitoring power whatsoever. In all states the PO steals the whole discretionary budget.*

*Proof:* See above.

The result in Proposition 5 may at first appear quite surprising because focusing verification on LQ services since the HQ services need not be checked at all seems common sense. The result reveals an essential limitation in the use of information about services in ex-post verification random mechanisms to monitor the PO. Indeed in any given class, focused verification reallocates the marginal probability of detection from states with a lot of stealing (and many LQ) to states with less stealing (and few LQ). The marginal detection risk decreases with the number of stolen units which creates perverse incentives. As a consequence the FV P-rule does not relax the liability constraint and therefore it has no more monitoring power than random verification.

**Remark 2** *Again the failure of common sense intuition about the value of focused verification reveals a conflict between the ex-post perspective of verification as an instrument to detect diversion and the ex-ante perspective of verification as an instrument to monitor action i.e., to minimize diversion.*

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<sup>18</sup>For simplicity we do as if PO's choice was continuous. This has no impact on the qualitative results

The conflict is due to the fact that the quality of service delivery is an imperfect signal of diversion, relying on it for verification makes the monitoring power of verification manipulable by the PO. It creates new incentives to divert i.e., to dilute the probability for being caught.

## 5.2 Performance target and verification

### 5.2.1 Simple performance target rules

Although the focus of the paper is on P-rule with information revelation. We provide some results about a simplest rule using information about service delivery with no verification. The first mapping  $f : S \rightarrow P$  is void since no verification is performed:  $f(\mathbf{s}) = (0, \dots, 0) \forall \mathbf{s} \in \mathbf{S}$ . The second mapping  $d : S \rightarrow \{K, D\}$  is defined as follows:  $d(\hat{s}) = K$  if  $\hat{s} \geq y$  and  $d(k, \hat{s}) = D$  if  $\hat{s} < y$  where  $y$  is a pre-announced target. In plain language, the P-rule boils down to a decision determined by the number of high quality services: if he meets the target, the PO is reappointed, if it does not he is dismissed.

The PO's incentives depends on the state  $\theta_i$  as follows: if  $\theta_i \in \Theta(k)$  with  $k < y$ , the PO's payoff writes

$$\frac{\hat{x}}{n}B + \text{prob}(K; \hat{s}), \hat{x} \leq k$$

where  $\hat{x} = \sum x_i$  is the number of services where the PO steals. Since the P-rule for  $\hat{s} < y$  entails  $\text{prob}(K; \hat{s}) = 0 \forall \hat{x}$ , the payoff boils down to  $\frac{\hat{x}}{n}B$  which is trivially maximized at  $\hat{x} = k$ . So when the target is not feasible ( $k < y$ ) the PO diverts the whole discretionary budget. In states  $\theta_i \in \Theta(k)$  with  $k \geq y$ , and since  $\text{prob}(K; \hat{s}) = 0$  for  $k - \hat{s} < y$  and  $\text{prob}(K; \hat{s}) = 1$  for  $k - \hat{s} \geq y$  the IC constraint induced by the target rule in those states is

$$\frac{k-y}{n}B + w \geq \frac{k}{n}B, \quad (8)$$

which simplifies  $w \geq \frac{y}{n}B$ . As we know this is satisfied for  $y \leq l$ . Hence for  $y \leq l$ , in all  $\theta_i \in \Theta(k)$  with  $k \geq y$  the PO will deliver any target  $y \leq l$  and steal the whole budget for any target  $y > l$ . The outcome will then be exactly the target in all states where it is achievable and LQ service everywhere else.

Recalling our notation  $q(y) = \text{prob}\{\theta_i \in \Theta(y)\} = \frac{n!}{y!(n-y)!}p^y(1-p)^{n-y}$  and  $Q(y) = \sum_{i=0}^{i=y} q(i)$  is the probability that the target is not feasible After substituting for the PO's optimal response CI's objective to maximize saved budget writes

$$\begin{aligned} \max_y \sum_{k=y}^{k=n} q(k)y &= \max_y (1 - Q(y))y \\ \text{s.t } y &\leq l \end{aligned}$$

Denote by  $y^*$  the largest integer value of  $y$  that maximizes the programme above. We derive wrt  $y$

$\frac{d}{dy} [(1 - Q(y)) y] = (1 - Q(y)) - Q'(y) y$  using the definition of  $Q(y)$  :  $1 - \sum_{i=0}^{y-1} q(i) - q(y) = q(y) y \Leftrightarrow 1 - \sum_{i=0}^{y-1} q(i) = (1 + y) q(y)$

This gives us the following result

- Proposition 5** *i. The optimal target P-rule entails a target  $y^* = \min \{l, \arg \max (1 - Q(y)) y\}$  ;*  
*ii. In equilibrium the PO delivers  $y^*$  high quality services iff  $\theta \in \Theta(k)$  with  $k \geq y^*$  while he steals the whole discretionary budget whenever  $\theta \in \Theta(k)$  with  $k < y^*$  ;*  
*iii. the optimal target P-rule yields a total saved budget of  $EV^T = (1 - Q(y^*)) \frac{y^*}{n} B$ .*

**Proof.** See above ■

The optimal target rule trades off the loss of the whole budget in states where the target is not feasible with the gain of an additional unit in states where the target is feasible. Comparing  $EV^T = (1 - Q(y^*)) \frac{y^*}{n} B$  with the full information case  $EV^{fi} = \sum_{i=0}^{l-1} q(i) \frac{i}{n} B - (1 - Q(l)) \frac{l}{n} B$ , we note that *i.* the first term of  $EV^{FI}$  representing the gain in the worse states is fully absent with the target rule; *ii.* the second term is quite similar in structure but  $y^* \leq l$  because the CI trades off the loss of the whole budget in states where the target is not feasible against the level of requested service delivery where it is feasible.<sup>19</sup>

**Remark 3** *The target rule is a simple and transparent P-rule. A major drawback is that it induces diversion in all states but  $\theta \in \Theta(y^*)$  and poor states are worst hit.*

In the Appendix we show how a non-deterministic reappointment rule based on target can be used to achieve the complete information payoff but at the cost of turning perverse.

### 5.2.2 Verification conditional on performance with respect to target

In this section we investigate simple composite P-rules that combine target with a verification procedure. Two variants are of interest. The first amounts to imposing a *necessary* target so if the target is met the CI proceeds to some verification but if it is not the PO is dismissed. The second type of rule imposes a *sufficient* target so if the target is met the PO is reappointed while if the target is not met the CI proceeds to verification.

**Verification with necessary target** Since we know that random verification has no monitoring power (see Proposition 2) we address the case of partial verification (equal probability check in  $M \subset N$ ) with necessary target. Specifically, partial verification with target is as follows:

<sup>19</sup>The question of interest is whether the optimal target rule improves upon the optimal APV :

$\sum_{i=y^*}^{i=n} q(i) \frac{y^*}{n} B \geq (<) \sum_{i=0}^{i=l} q'(i; M^*) \frac{i}{n} B$  which is equivalent to comparing  $\sum_{i=l}^{i=n} q(i) y^*$  and  $\sum_{i=0}^{i=l} q'(i; M^*)$  where  $y^*(w, p)$  and  $M^*(w)$ . The relative value of the two rules to depend on  $w$  and  $p$ . Intuitively, the target rule will outperform the APV rule when  $p$  is large for given  $w$ . In contrast the PA rule may be better when  $l$  large.

The necessary target P-rule is defined as follows  $f : S \rightarrow P$ , with  $p(s_i, \hat{s})$  :

- $p_i(s_i; \hat{s} \geq y) = \frac{1}{m}$ , for  $i \leq m$ ,  $p_i(s_i; \hat{s} \geq y) = 0$  for  $i > m$ ;
- $p_i(s_i; \hat{s} < y) = 0$ ,  $\forall i$ .

The second mapping  $d : S \times X_i \rightarrow \{K, D\}$  is defined as follows:

- $d(\hat{s}, x_i) = K$  if  $\hat{x} \geq y$  and  $x_i = 0$  and
- $d(x_i, \hat{s}) = D$  otherwise i.e., if  $\hat{s} < y$  or if  $\hat{s} \geq y$ ,  $x_i = 1$ .

Recalling Proposition 5ii. we know that if  $\theta \in \Theta(k)$ ,  $k < y$ , the target cannot be met and the PO steals the whole discretionary budget  $\frac{k}{n}B$  since he will be dismissed anyway. For the case  $\theta \in \Theta(k)$ ,  $k \geq y$ , consider two situations. Let as before  $k' \leq k$  be the number productive services in  $U$  when the state is  $\theta \in \Theta(k)$ . Then if  $(k - k') \geq y$ , there are enough high quality services in  $M$  to meet the target, the reasoning is similar to partial verification without target (APV), if  $m \leq l$ , the PO only steals in  $U$ .

If  $(k - k') < y$  (but  $k \geq y$ ) the PO needs to abstain from stealing on a number  $z = y - (k - k')$  of high productive services in  $U$  in order to meet the target. Since not meeting the target leads to dismissal, IC for securing the target is :

$$\frac{k - y}{n}B + w \geq \frac{\hat{x}}{n}B$$

since the position of services does not matter we write  $(k - y)$  as the number of services that he can steal from unsanctioned (this implies not stealing in  $M$ ), the rhs is increasing in  $\hat{x}$  so we can focus  $\hat{x} = k$ , the inequality simplifies to  $\frac{y}{n}B < w$ . Hence, when  $(k - k') < y$  (but  $k \geq y$ ) the reasoning is similar to the simple target rule and PO prefers to secure the target and steal what is left to steal in  $U$  than steal any larger amount provided  $y \leq l$ .

Compared with APV, the impact of the target is twofold: i. it secures at least  $y$  HQ services in all states where that is feasible and thus even in states where  $k - k' < y$  which APV fails to achieve; ii. That comes at a cost of losing the whole budget in states where  $k < y$ .

$$EV = (1 - Q(y))\frac{y}{n}B + \sum_{i=y}^{i=m} q'(i; M) \frac{i - y}{n}B \quad (9)$$

where we remind  $q'(z; M) = \text{prob}\{\theta \in \Theta(z; M)\}$  it is the probability that  $\theta = (\theta_1, \dots, \theta_m)$  has  $z$  high productivity parameters. The first thing is that for  $y \leq l$  the target is secured whenever feasible (first term in 9). In addition some additional HQ service may be secured if they happen to be in excess of  $y$  and in  $M$ . We note that  $y^{**}$  that maximizes (9) is smaller than  $y^*$  of the optimal simple target rule since the second terms decreases with  $y$ . We have the following proposition:

**Proposition 6** *Optimal Partial verification with target entails*

i. the same pre-announced verification set as partial verification without target and a lower target than the simple target scheme. Partial verification with target

ii. strictly improves upon the simple target scheme and

iii. weakly improves upon the partial verification scheme.

*Proof:*

i. This follows from proposition 3, the IC constraint within the set  $M$  does not depend on the true state and thus does not depend on whether the target is met or not.

ii. This follows from the fact that the expression in (9) has the same structure as (??) but with an additional positive term. In particular, the optimal target of the simple rule  $y^*$  is feasible and yields a larger saved budget.

iii. Consider the case with high wage i.e., when  $l$  tends to  $n$ , in that case imposing a target  $y > 0$  only brings forth the loss of the discretionary budget in poor states ( $k < y$ ) so  $y^* = 0$ . In contrast for  $l$  small e.g.,  $l = 1$  implying  $M = \{s_1\}$ , the gain from the target  $y = 1$  comes with large probability  $(1 - Q(1)) = 1 - (1 - p)^n$  overweighting the cost of *not* meeting the target which comes with a vanishing small probability  $(1 - p)^n$ .

Proposition 6 shows that the use of ex-post information by means of a necessary target to complement partial verification has some limited value. It is expected to improve accountability in context where the wage is very low relative to the budget i.e., in context where "first best" diversion is very high. On the other side, the simple target rule can be unambiguously improved upon by combining it with a verification procedure.

**Verification with sufficient target** In this section we address the case of partial verification (equal probability check in  $M \subset N$ ) with sufficient target. The distinction with the mechanism in the preceding section is that here fulfilling the target secures reappointment. Failing to meet the target does not trigger dismissal instead CI proceeds with a verification procedure. The necessary target P-rule is defined as follows  $f : S \rightarrow P$ , with  $p(s_i, \hat{s})$  :

- $p_i(s_i; \hat{s} \geq y) = 0, \forall i$ .
- $p_i(s_i; \hat{s} < y) = \frac{1}{m}, i \leq m, p_i(s_i; \hat{s} \geq y) = 0 \ i > m$ .

The second mapping  $d : S \times X_i \rightarrow \{K, D\}$  is defined:

- $d(\hat{s}, x_i) = K$  if  $\hat{s} \geq y$  or if  $\hat{s} < y$  and  $x_i = 0$ ;
- $d(\hat{s}, x_i) = D$  otherwise i.e., if  $\hat{s} < y$  and  $x_i = 1$ .

In any state  $\theta \in \Theta(k)$ ,  $k < y$ , the PO faces the APV scheme described in Section 4.1 and 4.2. We know that if  $m \leq l$ , the PO only steals in  $U$ . So the outcome is the same outcome as with APV.

In states  $\theta \in \Theta(k)$ ,  $k \geq y$ , the PO's chooses between delivering  $y$  services (and stealing  $k - y$ ) or stealing  $\hat{x} > k - y$  and facing partial verification. If all high productivity services are in  $M$ , the target

rule allows him to steal  $k - y$  in  $M$  and skip the verification which is worse than the APV outcome. Conversely, if all high productivity services are in  $U$ , the PO has no incentive to deliver any HQ and he will face the verification in  $M$  and be reappointed while stealing all the discretionary budget. So that is the same as in APV. The interesting cases are when not all  $y$  high productivity services are in either subsets. Consider now the case when some of the  $y$  high productivity services are in  $U$  in the sense that delivering  $y$  HQ requires refraining from stealing in  $U$ . The PO chooses between delivering the target and skipping the verification. Or failing the target and facing the verification in  $M$ . Since delivering the target requires the delivery of more productivity service than there are in  $M$ , the choice is obvious because the PO can secure reappointment when failing the target but complying in  $M$ . He gains nothing from complying with the target. We summarized this reasoning:

**Proposition 7** *A P-rule that combines a sufficient target with partial verification does strictly worse for any  $y > 0$  than the partial verification rule without target.*

*Proof:* see above

This result is somehow surprising because contrary to intuition offering an opportunity to skip the verification has no incentive value whatsoever in this context.

This section does not offer a complete investigation of the value of using information about services quality for accountability. Nevertheless procedures involving verification and a performance target are indisputably most relevant classes of accountability mechanisms. The results in Prop. 5-7 show significant limitations in the use of information about service delivery for accountability. An intuition for this result is that conditioning verification on the performance opens up gaming opportunity. First and in contrast with most analyzed persuasion situations, we are dealing with moral hazard in addition to adverse selection. Second, verification resources are limited. As a consequence the public officials has an incentive to take action that affect performance in order to manipulate detection risk. This is in particular clear in the case of focused verification (Proposition 5). It also underlies the reasoning behind proposition 7. We next show that the same intuition is behind the absence of value for accountability of announcements made by the public official.

### 5.3 On the role of announcements

We here discuss the value of requesting an announcement from the PO about the state of productivity and/or service quality. In the terminology of communication theory we now have an explicit sender, the PO and a receiver the CI. The question we ask is can communication improve upon the APV outcome by using these announcements?

*Observable service delivery*

Consider first the case with observable service delivery. We focus on announcement that are consistent with the observed vector of service delivery and with the production technology. Such announcements may either bring no new element e.g., announce  $\tilde{\theta}_i = \underline{\theta}$  when  $s_i = \underline{s}$  and  $\tilde{\theta}_i = \bar{\theta}$  when  $s_i = \bar{s}$ . Or PO effectively announces that he diverted if he claims  $\tilde{\theta}_i = \bar{\theta}$  when  $s_i = \underline{s}$  for some  $i$ .

We start with claims relating to services in  $M$  and assume he claims  $\tilde{\theta}_i = \bar{\theta}$  when  $\tilde{s}_i = \underline{s}$ , for some  $s_i \in M$ . In response to such a claim the P-rule may call either for an increase of the verification probability  $p_i$  or leave it unchanged.<sup>20</sup> Assume first the verification scheme is left unchanged. The reappointment rule must dismiss the PO if verification confirms the claim so diversion took place otherwise it would open a way to steal unsanctioned. The reappointment rule may or may not sanction lies i.e., if verification disconfirm the claim so  $\theta_i \neq \bar{\theta}$  so PO did not steal but he lied. Whether it is truthful so he diverted or if he lied but the CI does not change the probabilities, such a claim can never be optimal for the PO and it is strictly dominated if lying is sanctioned. If the mechanism reacts by increasing the verification probability, the claim can be used to manipulate CI's verification resource toward low productivity services  $p_i > \frac{1}{t}$  and away from high productivity  $p_j < \frac{1}{t}$  thereby reducing the chance to detect diversion and violating the IC constraint on those services. The same reasoning applies to a policy that would reduce verification probability. But that can never be optimal for the CI.

Now how about an announcement with some  $\tilde{\theta}_i = \bar{\theta}$  when  $\tilde{s}_i = \underline{s}$ ,  $s_i \in U$ ? If the CI verifies with positive probability but sanctions lies (and diversion of course), there can be no point for PO to make such a claim. If the claim is true he will be dismissed and if it is false he will be dismissed as well. If CI verifies with positive probability but does not sanction lies then, PO will use the claim  $\tilde{\theta}_i = \bar{\theta}$  when  $\tilde{s}_i = \underline{s}$  when either  $(\underline{\theta}_i, \underline{s}_i)$  (so he won't be sanctioned for diversion) to dilute the verification probability in  $M$  and the whole scheme breaks down. So CI could either only request announcement in  $M$  or discard announcement in  $U$  i.e., allowing PO to claim that he diverted without CI imposing any sanction.

If the mechanism does not react by changing verification probabilities (because that can be manipulated) or sanctioning lies (because the PO would never make untruthful announcement where verification would not lead to dismissal but of course would lie when he diverts) than announcements effectively play no role.

#### *Service delivery non-observable*

Here too we focus on consistent claims that is claims of the form  $(\bar{\theta}_i, \bar{s}_i)$   $(\underline{\theta}_i, \underline{s}_i)$ . Inconsistent claims can be either punished or discarded. We note that if either claim induces a change in the probabilities for detection, PO can and will use it to manipulate CI in order to reduce detection

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<sup>20</sup>We note that it is trivially precluded to respond to a "confession" by dismissal since the PO would then never make such claim.

probability from services where he diverted. For instance if CI verifies  $(\overline{\theta_i}, \overline{s_i})$  claims in  $M$  more often than  $(\underline{\theta_i}, \underline{s_i})$  claims (or the other way around) the IC will be violated for some services in  $M$ . The argument also applies if a claim prompts a verification in  $U$ . Hence again we see that there is no value for announcement in this context.

This short discussion suggests that explicit claims have no role to play in the APV. At least in terms of monitoring. This echoes the results about the value of using information about service delivery. But there may be a value of announcement in terms of the legitimacy of the sanction in case the PO announces he did not divert but diversion is detected and therefore also lying.

## 6 Social Accountability

In the previous sections we have established that there could only be limited gain to the use of information about service delivery in the accountability mechanisms that we investigated. In this section we introduce a new instrument that is rapidly spreading: service users' complaints. The idea is to make use of service users' superior information about the true state. We assume that service users are (with some probability) able to identify the reasons for the low quality of a service. They can see when e.g., a school is dysfunctionning because the teachers do not receive their wage i.e., basic resources fail to accrue to the school - a situation that corresponds to a high productive state denied resources. They can distinguish that from a situation where only part of the teacher positions have been filled or the teachers have very low qualification - a situation that corresponds to a low productivity state. We do not model service users explicitly at this stage. We do however conjecture that the results will hold for strategic service users with preferences sufficiently aligned with those of the CI.

The objective of this section is to show that when the CI has access to service users' complaints, requesting that the CI makes a public claim of his records allow for significant improvement in accountability in a context of asymmetric information.

### 6.0.1 Social accountability

We shall consider the case when the vector of service delivery is not observable by the CI. The mechanism requests that the sender, PO "defends his records": makes a consistent announcement about both the productivity and the quality of each service. Thereafter, the service users are invited to complain i.e., to refute the announcement with respect to well-identified services if they believe it is untrue. The refutation is cheap talk and service users do not provide hard evidence. We assume that they are sincere but they may be lazy and/or mistaken. A concern of practical relevance is that



the P-rule is little demanding of service users.<sup>21</sup>

Complaints are used to generate a signal, we shall not go into the details on how the signal is obtained. The idea is that a suitable algorithm aggregates the complaints received from service users e.g., on an electronic platform. We will show that there exists a P-rule using both announcements and complaints such as to approach the first-best outcome.

The communication phase of the game takes place after the PO made its allocation decision (see the *timing* in section 2). It includes a public message or claim from the PO and response from service users who may refute the claim. Let  $A : \{a_{i=0}^n\}$ ,  $a_i = (\tilde{\theta}_i, \tilde{s}_i)$  be the set of claims. The PO is requested to declare a state of productivity and a quality level for each service. We restrict the set of acceptable claims to consistent (technically feasible) ones and we denote by  $\alpha$  any claim that confess diversion i.e., irrespective of the combination and the extent of diversion. After having seen the claim, the service users privately post complaints on the platform. The set of acceptable complaints is denoted  $C$ . The platform accepts two types of complaints:

- Type 1: the PO claims the productivity and service quality is high  $a_i = (\tilde{\theta}_i, \tilde{s}_i) = (\bar{\theta}, \bar{s})$ , but user  $j$  posts a complaint  $c_i^{(1)j}(a_i) = (\underline{\theta}, \underline{s})$  i.e., contending  $(\theta_i, s_i) = (\underline{\theta}, \underline{s})$ . Type 1 complaints are not related to diversion and they are assumed perfect signals.<sup>22</sup>
- Type 2: the PO claims  $(\tilde{\theta}_i, \tilde{s}_i) = (\underline{\theta}, \underline{s})$  while service user  $j$  contend that  $(\theta_i, s_i) = (\bar{\theta}, \bar{s})$ , i.e.,  $c_i^{(2)j}(a_i) = (\bar{\theta}, \bar{s})$ . Type 2 complaints implicitly suggest diversion occurred, they may with some probability be mistaken.

All other messages by service users are discarded by the platform that processes the announcement and the acceptable complaints to produce a signal

$$\sigma : A \times C \rightarrow \Sigma, \sigma = (\hat{a}, i^*)$$

The first term  $\hat{a} = \#\tilde{s}_i; \tilde{s}_i = \bar{s}$  and such  $\#c_i^j(a_i) = 0, \forall j$  i.e., no complaint of any kind was posted on announced HQ service  $i$ .  $\hat{a}$  is a signal about the number of high quality services. The second term,  $i^*$  is a signal about which service is most likely to have been the object of diversion:  $i^* \in \arg \max_i (c_i^{(2)}, \dots, c_n^{(2)})$  where  $c_i^{(2)}$  is the complaint score (e.g., number of complaints) of service  $i$ .<sup>23</sup> It is (one of) the service(s) that has received the largest amount of type 2 complaints. For the case  $c_i^{(2)} = 0$  for all  $i$ ,  $i^* = v \notin N$  it does not correspond to any service.

<sup>21</sup>We return to this issue at the end of the section where we discuss alternative ways to implement the outcome.

<sup>22</sup>A false claim that everything is fine when it is not is very easy to identify and there will always be a service users outraged by the lie who complains.

<sup>23</sup>All services are assumed to have an equal number of users and those users have an equal propensity to complain and they are identical with respect to their accuracy.

Finally, let  $\delta = \text{prob}(\{s_i = \underline{s}\} \cup \{\theta_i = \bar{\theta}\}; i = i^*)$ ,  $\delta \leq 1$  is the probability that the PO diverted on service  $i$  conditional on service  $i$  having received the highest complaint score. It captures the informativeness of  $i^*$ .  $\delta = 1$  implies that  $i^*$  is a perfect signal. For simplicity we let  $\delta$  be independent of the total amount of diverted budget.<sup>24</sup>

The idea of the P-rule is as follows. For the case the PO admits that he diverted funds  $a = \alpha$ , he is fired without verification. If  $a \neq \alpha$  the following applies. If the announced and uncomplained about delivery performance is good i.e.,  $\hat{a} \geq y$  for some  $y$  to be defined, no verification will be performed. Otherwise verification occurs on  $i^*$  (one of) the service most subjected to type 2 complaints. If the announced performance is poor  $\hat{a} < y$ , verification will always take place on  $i^*$ . More precisely the complete Social Accountability P-rule (SAP) is as follows:

$f : A \times \Sigma \rightarrow P$  entails

- $p_i(\sigma; a = \sigma) = 0, \forall \sigma$ .
- $p_i(\hat{a}, i^*; a \neq \sigma) = 0$ , if  $\hat{a} \geq y \forall i$ ;
- $p_i(\hat{a}, i^*; a \neq \sigma) = 1$ , if  $\hat{a} < y$  and  $i = i^*$ ;
- $p_i(\hat{a}, i^*; a \neq \sigma) = 0$  if  $i \neq i^*$ .

$d : A \times \Sigma \times X_{i^*} \rightarrow \{K, D\}$  is defined as follows:

- $d(a, \sigma, x_{i^*}) = K$  if  $a \neq \alpha$ ,  $\hat{a} < y$  and  $x_{i^*} = 0$  or  $\hat{a} > y$  and
- $d(a, \sigma, x_{i^*}) = D$  otherwise i.e., if  $a = \alpha$  or  $\hat{a} < y$  and  $x_{i^*} = 1$ .

We next investigate the PO incentives to take actions and make announcements in response to this P-rule for some pre-announced target  $y$ . We shall proceed by backward induction. We distinguish between two regions of the state space depending on whether the target  $y$  is feasible or not: Region 1:  $\theta \in \cup_{k=0}^{y-1} \Theta(k)$  and Region 2:  $\theta \in \cup_{k=y}^n \Theta(k)$ .

Region 1: *A PO of type  $k < y$*

We first consider PO's choice of announcement. Note that there can be no point in announcing  $a = \alpha$  since the PO is then dismissed with probability 1. This means that for any  $\hat{x} > 0$ ,  $a^* \neq \alpha$ , the announcement effectively hides the truth on at least  $\hat{x}$  services. Next, whatever  $\hat{x}$ , and whatever  $a \in A$ ,  $\hat{a} \leq y$  because  $a > y$  will be refuted since there cannot be  $y$  services not complained about (which would lead to automatic reappointment) because  $k < y$ .<sup>25</sup> So the PO may just as well announce  $a$  such that  $\widehat{s}(\# \tilde{s}_i, s_i = \bar{s}) = k < y$ . The platform will always produce a signal  $\sigma$  with  $\hat{a} < y$ . The P-rule will induce the verification of  $i^* \in N$  with probability  $\delta$  PO is detected and loses his job. Since the risk of detection is independent of the number of diverted shares, the PO faces a binary choice i.e.,

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<sup>24</sup>It is a research task in itself to design the information processing algorithm to make best use of the information in the complaints. We here only consider a very simple technology.

<sup>25</sup>Recall that by assumption type 1 complaints are perfect signals.

whether or not to divert the whole discretionary budget i.e.,  $\hat{x} = k$  :

$$\frac{k}{n}B + (1 - \delta)w < w \Leftrightarrow \frac{k}{n}B < \delta w \quad (10)$$

within the set of states the most demanding constraint is at  $k = y - 1$ . Using earlier results, implying that for the IC to be satisfied we need  $y \leq \delta l + 1$ .

We conclude that for a PO of type  $k < y$  refraining from diversion and announcing the truth is optimal providing  $y \leq \delta l + 1$ . We note however that what announcement concerns the equilibrium is not unique. In fact any  $a \neq \alpha$  will induce  $\hat{a} < y$  and is consistent with a no stealing equilibrium in Region 1. So in particular the PO can overstate or understate performance (and the state of productivity). If however there is some positive value in showing that no service user complained, truth-telling dominates.

Region 2: A PO of type  $k \geq y$

If PO announces  $a$  such that  $\hat{a} \geq y$  so at least  $y$  services announced as high quality have not been refuted, it means that diversion is limited to  $\hat{x} \leq k - y$ . The PO is then reappointed without verification. While if  $\hat{a} < y$  suggesting  $\hat{x} > k - y$  there will be verification and detection with probability  $\delta$ . With the same reasoning as above the choice is binary between diverting unsanctioned  $(k - y)t$  units or with risk the whole discretionary budget,  $k$  units, IC writes:

$$\frac{k - y}{n}B + w > \frac{k}{n}B + (1 - \delta)w \quad (11)$$

$$\frac{y}{n}B - \delta w < 0$$

which is satisfied for  $y \leq \delta l$ . So, for  $y \leq \delta l$  it is optimal for the PO to divert on  $\hat{x}^* = k - y$ , to announce some  $a$  such that  $\hat{a} \geq y$  and since  $a = \alpha$  triggers dismissal, he will not be truthful on the  $k - y$  services where he diverts. So in equilibrium we have untruth announcement and complaints that do not lead to verification.

The CI's objective function writes

$$\max_y EV^{SAP} = \sum_{i=0}^{i=y} q(i) \frac{i}{n}B + (1 - Q(y)) \frac{y}{n}B \text{ s.t. } y \leq \delta l$$

which is maximized at  $y^* = \delta l$ , the calculus is the same as in the complete information case.

This gives us the following results. Let  $\delta$  denote the informativeness of the signal generated by the user's complaints,

**Proposition 8** *A P-rule using user complaints and announcements can achieve*

- (i) *high quality delivery of all productive services in every state in  $\Theta(k)$  for  $k < \delta l$  and*
- (ii) *high quality delivery of  $\delta l$  services in every state in  $\Theta(k)$  for  $k \geq \delta l$ .*
- (iii) *In equilibrium the expected saved budget is  $EV^{SAP} = \sum_{i=0}^{i=\delta l} q(i) \frac{i}{n}B + (1 - Q(\delta l)) \frac{l}{n}B$ .*

*Proof:* The proof follows from the reasoning above.

**Corollary 1** *In the absence of PO announcement, a P-rule built on complaints alone allows detecting diversion with probability  $\delta$  independently of the state. Such a P-rule fails to deter diversion in any state belonging to  $\Theta(k)$ ,  $k \geq \delta l$ .*

**Proof.** The logic of proof is similar to that of Proposition 1 showing the optimality of leniency. Even where  $\delta = 1$ , the delivery of more than  $l$  services can never be obtained. In good states  $k > l$ , the PO prefers to divert everything and leave. ■

Proposition 8 and its Corollary establish that a P-rule that uses information from service users and the PO's announcements can approach the complete information outcome. The role of the announcement in a context where refutation can be obtained from service users, is to make possible a state contingent leniency rule in a way similar to the optimal full information scheme. This contrasts with APV where leniency is state *independent* i.e., it applies fully and within the pre-announced subset  $U$ . With PO announcement and refutations, the leniency rule applies only in states where the target is feasible. The SAP (Social Accountability P-rule) secures full compliance (no diversion) in states  $\theta \in \cup_{k=0}^{m^*} \Theta(k)$  and it secures at least  $\delta l$  services in  $\theta \in \cup_{k=m}^n \Theta(k)$ . So because SAP is state dependent, for  $\delta$  close to 1, it dominates the APV even in the absence of announcement (Corollary). The role of complaints is further to guide verification so as to optimize the use of verification resources. The imperfect informativeness of the signal  $i^*$  bounds away the outcome for the first-best.

The result in Proposition 8 is consistent with Lipman and Seppi (1995). The parties involved in communication that is the PO and the service users have conflicting interests<sup>26</sup> with respect to the CI's decision about reappointment in some state of the world i.e., when the PO has diverted money from the provision of services. If the service users were able to prove their counter claim, the failure of the service users to refute PO's claim with respect to any service could be used as sufficient evidence to prove that the claim is true. No verification by the CI would then be needed. In our context users' complaints are not hard evidence. Instead they are used to guide verification to provide the evidence of diversion. Another issue is that in our context the CI does not care about truth per se. What he cares about is diversion. So in particular false claims that do not hide diversion can be used to manipulate verification as we already noted in section 5.4. By distinguishing between (type 1) complaints against false "good news" hiding low productivity state with low quality service from (type 2) complaints that may hide diversion, the SAP-rule contains PO's incentives to falsely claim good news.

The result in Proposition 8 also underlines the significance of the informativeness of the signal produced by the platform. An immediate recommendation is for the CI to devise a platform which

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<sup>26</sup>We identify the service users' interest with those of the CI.

processes information so as to generate the most informative signal about diversion.

Finally, it should be noted that the reliance on communication i.e., claims and refutations is related to a concern for simplifying service users' contribution. The same outcome could be implemented without PO claims but with a more sophisticated participation of service users. Instead of the PO making definite claims, the CI would communicate to service users the "principles for PO proper behavior in every situation" and would ask to report deviations from those principles for every service. Obviously, such a scheme is much more demanding of service users compared to the SAP which only expects a refutation of an explicit claim. Given that service users' participation both with respect to sophistication and intensity is an issue in practice, the SAP that builds on communication is of greater practical relevance.

## 7 Concluding Remarks

This paper is concerned with a situation where a public official has been delegated the task to allocate resources for the production and delivery of public services. But he may divert money to his own pocket. The institutional context is characterized by a fixed wage and limited liability: the public official may at worst be dismissed.

We are interested in the monitoring value of a number of ex-post accountability mechanisms i.e., persuasion rules that rely on limited verification resources and may use communication.

Our first finding is that because of the fixed wage, the first best complete information outcome exhibits diversion of funds in some states. The optimal accountability mechanism departs from the zero tolerance principle. Instead, it is characterized by a satisfaction level (e.g., a number of high quality services) above which the PO is implicitly allowed to divert funds. In the absence of any information about the PO's behavior, the optimal P-rule based on random verification calls for verification in a pre-announced subset of services. Surprisingly, the availability of information about the quality of service delivery (a signal of PO's behavior) is of little value. In particular we find that a most intuitive mechanism which consists in a rule that calls for the verification of services where diversion might have occurred i.e., low quality services is a very bad idea. It leads to maximal diversion. The intuition is that such a rule increases the PO's cost of refraining from diversion in the first place. Instead diluting detection probability maximally by diverting whenever possible becomes optimal. We show that combining random verification with a necessary performance target weakly improves upon the optimal selective random verification outcome. But we find that asking the public official to defend his records is of no value in those mechanisms. However, the picture changes dramatically as we introduce service users and invite them to submit cheap talk complaints. We show that requesting that the public official publicly defends his record when service users can refute his claim can be

exploited in a mechanism that approaches the complete information first best. This result supports the intuition behind social accountability initiatives. It reveals that a well-designed persuasion game involving the public can play a significant role in securing the accountability of public officials and reducing the extent of corruption.

The analysis offers a framework that can be generalized along various dimensions to provide concrete recommendations as to how new technology can be used to improve governance.

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## APPENDIX

### 8 *Target rule with non-deterministic reappointment rule*

The rule is as follows:

$$d : S \rightarrow \Delta \{K, D\} :$$

$$- d(\hat{s}) = K, \hat{s} \geq l,$$

$$- d(\hat{s}) = \min \left\{ 1, \frac{\hat{s}}{l} \right\} K + \left( 1 - \min \left\{ 1, \frac{\hat{s}}{l} \right\} \right) D \text{ for } \hat{s} < l.$$

The PO's payoff writes

$U = \hat{x} \frac{B}{n} + \min \left\{ 1, \frac{k-\hat{x}}{l} \right\} w$ , implying  $\frac{\partial U}{\partial \hat{x}} < 0$  for  $k < l$  so  $\hat{x}^* = 0$  and  $\frac{\partial U}{\partial \hat{x}} > 0$  for  $k \geq l$ . The P-rule achieves the first best complete information outcome :  $\hat{x}^* = \max \{0, k - l\}$ .

This scheme features a number of highly unattractive features. In particular

- In equilibrium an honest but unlucky PO is systematically dismissed while a (lucky) PO who diverts is never dismissed.

- The lower the wage, the smaller  $l$  and the more often the (honest) PO is dismissed.

This means that dismissal is not a signal of embezzlement but of honesty! As a consequence the assumption that the PO loses (his continuation wage)  $w$  because after dismissal he finds no job is not sustainable. Especially with a high turnover: unlucky PO will be easily hired again which reduces the differential continuation wage when remaining in office. This in turn means a large extent of equilibrium embezzlement  $\frac{(k-l)}{n} B$  since  $\frac{dl}{dw} \leq 0$ . Thus we see that a non-deterministic reappointment rule may achieve first-best but at the cost of providing the wrong signals which undermines the



incentive power of the threat of dismissal. This complements the argument made in the Introduction for confining attention to deterministic reappointment rules.